Sugarcane Bioenergy Inquiry 2025

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Submission to inquiry into sugarcane bioenergy opportunities in Queensland

OCTOBER 2025

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AGFORCE THE LEADING VOICE FOR QUEENSLAND PRODUCERS

AgForce is a peak organisation representing Queensland's cane, cattle, grain and sheep, wool & goat producers. The cane, beef, broadacre cropping and sheep, wool & goat industries in Queensland generated around $11.2 billion in on-farm value of production in 2022-23. AgForce is the leading voice for Queensland producers and strives to ensure the long-term growth, viability, competitiveness and profitability of these industries. Over 6,000 farmers, individuals and businesses provide support to AgForce through membership. Our members own and manage around 55 million hectares, or a third of the state's land area. Queensland producers provide high-quality food and fibre to Australian and overseas consumers, contribute significantly to the social fabric of regional, rural and remote communities, as well as deliver stewardship of the state's natural environment.

Submission

AgForce members continue to advocate for diversification pathways for farming businesses, we are encouraged to provide a submission to the Parliament's Primary Industries and Resource Committee's inquiry into sugarcane bioenergy opportunity in Queensland. We acknowledge the Queensland inter-government submission to the inquiry, as an excellent factual outline of the sugarcane bioenergy parameters.

EXECUTIVE SUMMARY

Australia's sugarcane industry is at a pivotal moment. While it has long been a global leader in productivity and innovation, the sector now faces rising pressures from ageing infrastructure, high input costs, volatile world sugar prices, and growing regulatory burdens. Producers and industry stakeholders are united in the view that diversification and modernisation are essential to secure the future of the industry and deliver value to regional communities.

Queensland farmers manage over 320,000 hectares of sugarcane, producing 30 million tonnes of cane annually. This output underpins 20,000 jobs and contributes more than $3 billion to the economy, making sugarcane the state's second-largest agricultural commodity by value. The sector has mapped potential to expand by a further 60% and is placed to leverage one of Australia's most significant opportunities to strengthen regional economies, drive energy and fuel security, and contribute to emissions reduction targets.

Modernising mill infrastructure is central to this opportunity. Upgrading cogeneration plants to harness bagasse could increase renewable electricity generation capacity from 350 MW to 800 MW, enough to power half a million homes, while preserving crystal sugar (sucrose) production and diversifying producer and mill manufacturing revenues. Similarly, biofuel pathways from sugarcane, including ethanol, Sustainable Aviation Fuel (SAF), and Renewable Diesel (RD), present proven and emerging opportunities, though they require long-term policy certainty, funding - concessional finance, and investment in both bioenergy/biofuels refining infrastructure and market mechanisms that will support capacity for growth and to reach scale.

Global demand for biofuels is accelerating. Brazil, the United States, and the European Union have shown that blending mandates, long-term finance, and integrated supply chains can rapidly scale production. In contrast, Australia's domestic biofuel output—currently less than 200 million litres per year against a consumption of nearly 60 billion litres, highlights the urgency of decisive action. Without clear policy, Australia risks falling behind and losing the opportunity to leverage sugarcane as a feedstock for bioenergy or biofuels - low-carbon liquid fuels.

Producers emphasise that public investment must deliver shared benefits. Conditions for support should include income-sharing arrangements, reinvestment into manufacturing networks, and safeguards to preserve sucrose markets. Above all, policy and funding mechanisms must be structured to avoid shifting additional costs onto producers, supply chains, or end-users, while creating durable frameworks that attract private capital and unlock new markets.

Visionary Pathway Forward

The pathway forward is clear: invest in mill modernisation, prioritise cogeneration and biofuel diversification, consider mill relocations; ensure producer and community benefit and legal protections (i.e., business firewall provisions); restore profitability and mill efficiency to the sector, and build supporting policy framework that maximises whole-of-crop utilisation, byproducts, preserves core sugar markets, and positions the industry as a foundation of Australia's renewable energy transition; in consultation with producers, manufactures, stakeholders, community and government policy makers. Milling sector is best placed to contribute to manufacturing expansion capabilities and byproduct diversification outputs, given the right mix of long-term policy and financial instruments, the sugarcane industry can deliver economic, environmental, and strategic benefits for generations to come.

Summary of Key Recommendations

1. **Modernise all sugar mills** to improve sucrose efficiency and expand into cogeneration, SAF, and renewable diesel, with focus on profitability of sector.
2. **Prioritise modernisation** particularly utilising byproduct bagasse into electricity co-generation, and biofuels through clear government strategy, changes to operating methodology, regulatory certainty, and suitable funding arrangements, with modernised feedstock supply agreements.
3. **Ensure producers and community (directly) benefit** from public investment into the manufacturing sector.
4. **Establish Revenue Sharing** a *bioenergy, biofuel and by-product - revenue sharing formula ('byproduct statutory formula')* and long-term supply arrangements.
5. **Mandate reinvestment** of a portion of manufacturing revenue into infrastructure upgrades and efficiency.
6. **Funding Structure** of public monies as long-term concessional loans, repaid from electricity and biofuel revenues.
7. **Preserve crystal sugar production** as the sector's core-business model, with diversification designed to complement, not displace, existing markets.
8. **Season lengths Commitments** more efficient mills, secures 21–23-week crush to protect core sugar operations.
9. **Policy Certainty** via long-term policy support and regulatory reform to enable sector diversification and expansion.
10. **Fast-track emerging biofuel technologies** to enable minimum 10% drop-in biofuel blend across the fossil fuel market, build biofuel/fuel processing facilities and fuel storage capabilities that improves onshore fuel security.
11. **Whole-of-crop utilisation** through investment in genetics, technology, and new product diversification pathways.
12. **Safeguard industry** through Business Firewall (legal) Provisions, integrity with ownership protections and first right of refusal provisions.
13. **Strategic Mill relocation or expansion:** Priority should be given to locations that maximise production efficiencies, offering strong rail and water infrastructure, access to feedstocks, minimal urban encroachment and provide improved environmental outcomes
14. **Financial instruments** designed with a long-term horizon (25–50 years) to de-risk private capital and secure industry growth.
15. **Cost pass-through protections** for agricultural farm businesses and regional communities by ensuring biofuel costs are not passed on to producers, supply chains, or end-users.

INTRODUCTION

This submission outlines producer and industry views on modernisation the sugarcane industry and manufacturing sector, including potential public investment support. It assesses most suitable bioenergy pathways for sugarcane industry, based on production data and key assumptions (see Appendix C).

Sugarcane farmers manage 324,000 hectares of land in Australia, with capacity to scale up 60%, based on mapped farmland (532,000 ha). From this area, farmers produce 30 million tonnes of sugarcane annually, and mill manufactures yield around extract 4 million tonnes of sucrose (crystal sugar), with Commercial Cane Sugar (CCS) content (industry upper average of 13.68). The sector directly supports over 20,000 jobs and contributes $3 billion to the Australian economy, recognised as Queensland's second largest agricultural commodity by value after beef cattle.

Apply the agricultural local multiplier effect, (while no single widely published number exists) the result translates to the sugarcane industry being one of the strongest contributors to regional communities in economic value, underpinning small businesses, community services, transport, supply chains, and local investment.

Since the announcement of this inquiry on 11 June 2025, consultation with producers and stakeholders has revealed mixed views. Industry representatives are generally supportive of bioenergy proposals, while producers are divided, about half see biofuels as a future pathway, while the others half prefer to continue with crystal sugar production. A common sentiment among producers is frustration - *"we have been talking about bioenergy/biofuels industry for decades, yet another review and nothing has come out of it"*. As one policy submission noted, "biofuels industry stakeholders are urging Federal policy action now to realise the opportunity before it is lost to overseas producers" (Queensland Government, 2025).

Despite the differing views, all producers and stakeholders agreed diversification of the Australian sugarcane industry is at essential. Building on the Sugar Plus Roadmap 2022[1], there was strong industry consensus that now is the time for Australia to identify sugarcane bioenergy pathways and make clear investment decisions to secure sugarcane production as a key food and fibre export for the next generation.

[1] Sugar Plus Roadmap 2022: Fuelling the Future of Food, Energy and Fabrication

SUGARCANE INDUSTRY MODERNISATION - ESSENTIAL

The sugarcane industry is at a pivotal juncture. The future of the sugarcane industry in Australia is contingent on farm business being productive and profitable. Producers have squeezed every drop out of farm productivity.

The aging mill manufacturing, rail and infrastructure constrain the sector, i.e., seasons lengths, while rising prices of critical input costs, record machinery prices, regulatory pressures - red tape / green tape (i.e., reef and environmental regulations), high land values, high access to finance, and volatile world sugar price all erode profitability and reinvestment capacity into the sector, and communities. These pressures are particularly difficult for small producers, causing them to exit or sell to urban expansion, as seen in districts such as Mossman and Gordonvale. Industry success can no longer rely solely on individual effort; rather, it requires a coordinated approach of policy, regulation and legislation to drive industry efficiency, scale and growth. The industry must seek to restore profitability to (small) farm businesses through improved mill efficiency, enhanced manufacturing performance and diversification into high-value-add byproducts.

Historically, Australia has been a global leader in sugarcane production, innovation, manufacturing and technology adoption. However, in recent years output has plateaued and the industry risks being overshadowed by competitors such as Brazil, India, Thailand, and China. From a production high of 31.25 million tonnes in 2022, volumes have declined, reflecting structural challenges and decline in world raw sugar price. The proposal to diversify and modernise the sugarcane industry toward bioenergy from sugarcane is a welcomed necessity and opportunity for our nation.

Recommendations

- All sugar mills should be afforded the opportunity to modernise into state-of-the-art, efficient sugarcane (sucrose) processors, while also developing cogeneration capacity (location suitable, i.e., 10 to 11 mills proposed) for renewable electricity generation. The balance of Mills manufactures should also be positioned to transition into Sustainable Aviation Fuel (SAF) or Renewable Diesel (RD) production facilities, ensuring adoption of emerging technologies, with a focus on profitability of the sector.
- Modernisation should be prioritised by government through a clear strategy, regulatory reforms, and business case development, with changes to operating methodology and supported by appropriate public investment funding and/or financing arrangements, with modernised feedstock supply agreements.

INVESTMENT OF PUBLIC FUNDS

There is conditional support for the use of public funds to modernise sugarcane manufacturing for efficiencies and diversify into bioenergy and biofuel production facilities.

Industry has concerns with foreign-owned companies receiving taxpayer support. The expectation is reinvestment into factory infrastructure for efficiencies and global competitiveness should form part of "business as usual", and long-term business planning cycles. The reality is that infrastructure and diversification costs in Australia are substantially higher than in competitor nations. Given the maturity of Australia's crystal sugar industry, diversification into bioenergy and biofuel presents the most viable pathway for growth and scalability.

The basis for the investment of public sector funds, rests on two points, the first, the Australian sugarcane industry is an integral part of Australia production systems, and must keep pace with our competitors, and second the opportunity to expand into bioeconomic markets, hydrocarbons, and cane-derived by-products that generate long-term value (as highlighted in the *Sugar Plus Roadmap 2022*). However, without coordinated investment, these opportunities risk being lost to overseas industries with stronger government support and more attractive cost structures.

Public funding for industry sectors is not without precedent. Several, notable, Australian sectors have received significant taxpayer support to sustain operations, or manage structural change, here are some examples:

- Mount Isa Mines, (Glencore copper smelter): $50 million support package, $20 million economic structural adjustment (worker/community), $30 million "Mount Isa Acceleration Program" – resources, supports and incentives (July 2025).
- Qantas Airlines: $2.7 billion, "Aviation Support Package" and $800 million in JobKeeper wage subsidies, (2020-2021).
- Automotive Industry: $30 billion (1997-2012)[2], 'Car industry assistance' (productivity commission), $300 million (2014-2017) to component manufactures.
- Coal-fired Power Stations: $5.5 billion (2012), 'clean energy package'
- Renewable Energy Projects: Billions in concessional lands and grants (since 2012) for 'wind and solar industries', from Australian Renewable Energy Agency (ARENA) and Clean Energy Finance Corporation (CEFC).

Over decades, governments have offered public funds in form of grants, feasibility studies, co-project investment funding, some successful, others do not materialise, (e.g., Oceania Biofuels $500 million project[3]). However, the principle remains: strategic public investment can de-risk private capital, accelerate technology adoption, and secure domestic industries in times of transformation, particularly in proven economic sectors, such as the sugarcane industry.

Investment of public funds into the modernisation of the sugarcane industry should also consider the strategic relocation or expansion of mill operations to maximise production efficiency and long-term

[2] https://www.drive.com.au/news/productivity-commission-report-calls-for-an-end-to-australian-car-industry/
[3] Oceania Biofuels pulls $500m Gladstone project as another bubble bursts | RenewEconomy

viability. Relocation planning should target areas that can expand available cane supply per hectare, improve rail and logistics access, enhance feedstock combination availability through integrated sourcing, and deliver stronger environmental outcomes.

For example, a relocation of the Gordonvale Mill, which is increasingly constrained by urban expansion from Cairns, in favour of modernising the Babinda Mill—a location offering existing rail connectivity, reliable water access, improved environmental outcomes, and freedom from urban encroachment. Such strategic repositioning would enhance operational efficiency while supporting sustainable regional development.

Recommendations – Conditions to Investment of Public Funds

The investment of public funds (taxpayer dollars) in support for sugarcane manufacturing modernisation and diversification should be conditional on the following:

- Producer Benefit: Sugarcane manufacturers and producers have an intertwined relationship; producers (and communities) must directly share in the value of any publicly supported investment to manufacturing sector, for the benefit of improved producer and miller relationships.
- Revenue Sharing: In addition to the statutory sugar price formula (which should be reviewed in the future regardless these considerations – as referenced in public briefing on 30 April 2025), a *bioenergy, biofuel and by-product - revenue sharing formula* ***('byproduct statutory formula')*** should be established, reflecting both short-term and long-term feedstock supply arrangements for new markets. (This replaces AgForce earlier stance to the parliamentary committee for producer equity across milling operations, recognising that not all producers seek ownership involvement).
- Reinvestment Plans: A portion of future manufacturing revenue must remain in Australia and be reinvested in sugarcane manufacturing and infrastructure efficiency (e.g. through a "sinking fund") to ensure future cycles of investment keep pace with future modernisation costs.
- Funding Structure: Public funding to sugarcane manufacturing sector, should be structured as concessional, long-term loans, as preference, repayable from electricity co-generation or biofuel production revenues, supported by long-term contracts embedded in regulation.
- Preservation of Crystal Sugar Production: must remain a long-term core business strategy of the milling sector. Diversification into biofuels should complement, not displace, existing raw sugar manufacturing, rather, aim for increasing value per hectare in line with emerging demand *(Sugar plus roadmap 2022)*[4].
- Season Length Commitment: Mills commit to maintaining 21–23 week crushing seasons for crystal sugar production, independent of feedstock requirements for co-generation or biofuel production, except in extraordinary circumstances (e.g. weather events).
- Policy Certainty: The sector requires significant government policy and regulatory support to provide certainty, to enable a diversified sector to compete and allow land under cane to expand as viable industry.

[4] Sugar-Plus-Roadmap 2022-document.pdf

- Whole-of-Crop Solutions: Investment should encourage integrated use of 'mining all of crop', as advances in genetics and technology enable new diversification pathways and considerations to alternative feedstock combinations and sources.
- Ownership Protections: Establish safeguards - business firewall (legal) provisions between Australia and international operations. Milling and by-product -assets must not be fragmented or sold off in ways that undermine industry integrity. Protections should ensure assets remain whole, with contractual *first right of refusal* provisions in place to safeguard long-term domestic industry benefit and national sovereignty.
- Strategic mill relocation or expansion: of operations to maximise efficiency, secure long-term feedstock access, offer strong rail and water infrastructure, minimal urban encroachment, and provide enhance environmental outcomes.

With the right mix of policy, regulation, long-term contractual certainty, and structured public investment, the modernisation of sugarcane mills can strengthen the sector's triple bottom line, improve the regions multiplier effect, and deliver compounding returns for producers, manufacturers, communities, and the nation.

CHARTING THE BEST PATHWAY FORWARD

The *Sugar Plus Roadmap (2022)* addresses four broad measures for the strengthening and development of the sugarcane industry; being ***reliability*** (of production), ***efficiency*** (along value chain), ***scale*** (enhancement new and old, and investment), ***growth*** (profitable across spectrum, and re-investable). Achieving these measures requires significant government policy support, strong collaboration across the sector, and a focus on both improving business-as-usual and adding value along supply chain through diversification.

Analysis of bioenergy pathways which aligns with the above criteria and existing sugarcane business model is the better utilisation of bagasse – a by-product of crystal sugar manufacturing – offering a reliable feedstock for diversification and conversion into renewable electricity, biofuels, i.e., bioethanol, Renewable Diesel (RD), Sustainable Aviation Fuel (SAF) or other value add by-products.

Diversification is only achievable providing it is underpinned by supportive policy levers and by modernising all mills, which will deliver more efficient sugarcane processing into crystal sugar, while enabling diversification of production into co-generation of electricity or biofuels.

Among pathways assessed, in addition to continued production of crystal sugar; the cogeneration of electricity from bagasse is the most promising, proven pathway forward, offers the most synergies, leverage, and economic value to parties and benefits to regional communities. *See table 1, in comparison with table 2*.

Table 1: Production Value of Current Sugarcane Pathways – Annual Estimates.

Output - Pathway	Production Output *(tonnes/liters/ per year)*	Market Price ($)	Total Production Value (AUD)	Notes
SUGARCANE PRODUCTION PATHWAY				
Crystal Sugar (Sucrose) Only	4/Mt	$500/t	$2,000,000,000	$200,000,000 *(10% Producer Share (AUD))*
CURRENT SUGARCANE BYPRODUCTS				
Molasses Stand Alone (Export Value) ^	1.2/Mt	$250/t	$300,000,000	(varies-cents in the dollar)
Ethanol (from Molasses) ^^	300 ML	$1.565 /L	$470,000,000	Competes with Molasses Market
Cogeneration → Bagasse → Electricity (QLD grid) *	~3.8 M MWh	$90/MWh	$340,000,000	Proven pathway, regional benefit
Mill Mud and Ash (dry/wet)	**~**2 /Mt	Mud $6-63/t Ash $7-$9/t	~$12,000,000 – 120,000,000	*(Retail + value varies with delivery costs, averages ~$10–20/t)*

Assumptions – *(also, see table 4 and Appendix C).*
^Ethanol yield: ~250 L per tonne of molasses (rule-of-thumb for ~50% fermentable sugars), conversion of 1.2Mt of molasses x
^^IPART wholesale benchmark ethanol price $1.565, (1 March 2025).
Cogeneration. Theoretical load: 9 Mt bagasse × ~7.5 GJ/t × 25% efficiency =* *~4.7 TWh*** *(4.7 million MWh) x (80% available for export) = (3.76 TWh) ≈ 3.8 M MWh net export (after 20% mill use)*

Each production pathway carries a product opportunity cost, which varies depending on product pathway chosen, the production of ethanol limits the production of molasses etc.

For the purposes of this submission, byproducts not yet developed into stand-alone commercial pathways or export market, such as bagasse/ biogas, cane leaves tops/trash or bagasse pellets have been excluded but remain prospective market opportunities to investigate.

Recommendation

- The government should prioritise investment into the modernisation of sugar mills to enable the greater processing efficiencies of crystal sugar and **improved utilisation of bagasse for cogeneration of electricity and advanced biofuel production.**

MILL COGENERATION MODERNISATION

"Upgrading cogeneration infrastructure at Queensland sugar mills presents a potential opportunity to increase renewable energy from bagasse and contribute to a reliable, low-emissions system." (QLD Government 2025)[5].

At the public briefing on 30 April 2025, the Australian Sugar Manufacturers (ASM) presented an opportunity for significant investment to modernise 10–11 mills, through reconfiguration, and use of more efficient 'high pressure boilers', which will enhance existing renewable electricity cogeneration capacity output from 350 megawatts (MW) to 800 megawatts (MW), producing renewable baseload electricity equivalent to powering 500,000 homes. This would be achieved by utilising the 9 million tonnes of bagasse generated annually as a by-product of sugar manufacturing and the industry continues to produce raw sugar, while establishing a diversified long-term revenue stream

Cogeneration is a proven diversification pathway. Mills already generate and export electricity to the grid. While revenues from electricity may be not as high as potential biofuels pathways, they are more stable, less exposed to global biofuel price volatility, and can be underpinned by long-term Power Purchase Agreements (PPAs). This stability makes cogeneration an attractive diversification option, complementing existing sugar production and delivering regional economic benefits. (Table 2, highlights the annual economic values).

Government support will be essential. Modernisation of mills into co-generators should be prioritised within Queensland policy and regulatory frameworks, supported by cost-benefit analysis, business case development, and concessional financing repayable through electricity sales into the grid. Public investment should be designed to avoid disruption to core sugar operations and ensure mills retain exemption status under the National Energy Market, recognising that their primary business is sugar production, not electricity generation.

Cogeneration strategies should also consider ways to extend electricity supply beyond the sugar crushing season - aligning with Queensland's peak demand periods (January and March). At the same time, the pathway must carefully consider existing feedstock supply agreements against byproduct specific feedstock supply agreements, and the opportunity cost of diverting bagasse from future biofuels production, given national priorities around fuel security and carbon abatement.

Recommendation

- The government prioritise the modernisation of sugarcane manufactures into efficient congenators of electricity from bagasse, supported by policy that includes concessional loans, long-term supply contracts, and regulatory certainty to ensure viability while maintaining mills' core focus on sugar manufacturing.

[5]QLD Government – Submission to sugarcane bioenergy inquiry 2025

Table 2: Co-Generation output from Bagasse and potential wholesale revenue - Annually

Scenario	Capacity (MW)*	Operating hours (h/yr)	*Gross output (≈ TWh)	Net export (TWh) @80%*	Revenue @ $136/MWh	Revenue @ $188/MWh	Notes
Current Load (Co-gen - 350) **	448	4000	1.8	1.44	$195,840,000	$270,720,000	Crush season operation/ ASM figure on exportable base load
Current load (co-gen)	350	4000	1.4	1.12	$152,320,000	$210,560,000	
Upgrade A:	600	4,000	2.4	1.92	$261,120,000	$360,960,000	6-month crush
Upgrade B:	600	7,000	4.2	3.36	$456,960,000	$631,680,000	year-round crush
ASM proposal (baseload) ^	800	7000	5.6	4.48	$609,280,000	$842,240,000	Baseload with new HP boilers^/ condensing turbine, mill electrification

Assumptions and Terms *(Also see appendix C)*
- Terawatt (TWh), Megawatt (MW)
**Revenue (AUD)=Net Export (MWh)×Wholesale Price (AUD/MWh).*
***Current load 448 MW, installed capacity - Only 80% base load capacity exported to the grid, with 20% used in sugarcane production.*
- Historical co-generation revenue scenarios range $60-$120/MWh, we have used more recent Australian Energy Regulator AER's, latest Q2-2025 wholesale figures ranges of $136-$188/MWh.
- Exceptional peak wholesale price ranges of $6,798/MWh to $12,179/MWh, for some 30-minute trading intervals, in January 2022.
^High Pressure Boilers (HP), improve efficiency between 10-20% or mean uplift in gross electric output of 15%.

AUSTRALIA'S LIQUID FUEL CONSUMPTION

The global demand for biofuels is growing exponentially, and supply has quadrupled since 2014[6]. The Sugar Plus roadmap (2022) identified, *"demand for sustainable hydrocarbons from farming rather than the fossil fuel industry will likely increase significantly over the next 10 to 20 years, especially for bioplastics and biofuels for heavy transport and/or aviation."*

Australia's liquid fuel consumption is near 60 billion litres annually (table 3, highlights per sector consumption). The domestic production of biofuels (ethanol and biodiesel)[7] in 2022 was only about 200 million litres. Australia's liquid fuel production capacity has been declining since 2017, while demand has continued to increase.

Australia has a growing fuel security need, and with limited on shore processing capacity, an opportunity exists to build biofuel/fuel processing facilities and fuel storage capabilities along the regional coast and inland regions at source feedstock locations, with producers as the feedstock suppliers, providing long-term fuel security and access.

Table 3: Australia's liquid fuel consumption – Annual Estimates

Transport	Aviation	Agriculture	Mining	Marine	Petrol	Defence	Yealy total
12 billion litres	10 billion *(7.7 billion in 2023)*	2 billion litres	5 billion litres	14 billion litres	16 billion litres	400 million litres	*57.4 billion litres

Assumptions: *(Also see appendix C)*
**All figures have been round to nearest 10'*

By international comparison, Australia lags behind major sugarcane competitor nations, in the production of biofuels.

- Brazil (2020): Consumed 150 billion litres of liquid fuel, and produced 30 billion litres of bioethanol, contributing to the nations target mandate E27 (now E30, effective 1 August 2025).
- USA (2022): Consumed 520 billion litres of fuel, producing 60 billion litres of bioethanol toward the nations E10 mandate.
- EU (2023): Consumed 450 billion litres of liquid fuel and produced 20 billion litres of biofuels.

Recommendation

- Policymakers should consider all measures to fast-track Australia's Low Carbon Liquid Fuel agenda, particularly Australian designed initiatives, enabling the technologies and biofuel refineries to deliver at least a minimum 10% drop-in biofuel blend across the fossil fuel market, creating a cost-effective and sustainable renewable fuels sector

BIOFUEL PATHWAYS FROM SUGARCANE

There are several proven and emerging sugarcane-to-biofuel conversion pathways. While the production of ethanol from sucrose is a mature and well-established technology in many countries, the conversion of sugarcane into Sustainable Aviation Fuel (SAF) and Renewable Diesel (RD) remain in early

[6] https://www.cefc.com.au_refined-ambitions-exploring-australia-s-low-carbon-liquid-fuel-potential.pdf
[7] Australian Government – snapshot of world biofuels 2022

stages of commercial development. These emerging technologies will require further investment and policy support before they can be scaled to meet market demand.

Domestic Biofuel pathways

Table 4 highlights domestic biofuel pathways, their indicative production outputs, and estimated economic value. Among these is SAF which represents the most promising opportunity from sugarcane as a byproduct, and for long-term market growth, particularly given costs can be distributed across the international aviation sector.

In contrast, biodiesel production from sugarcane is still an emerging technology in Australia and is not yet competitive with North American or Brazilian manufactures, underscoring the need for further development and scale.

Appendix B, demonstrates examples of international biofuel technologies at both commercial and pilot scale, highlighting the feasibility of these pathways and reinforcing the opportunity for Australia to leverage the international pioneers.

Opportunity Cost

Although crystal sugar to ethanol (generation 1 technology) as a conversion pathway has been included to assist baseline comparisons, (and given its global track record); this pathway is not supported many producers as a preferred option, as it diverts sucrose away from established sugar markets (opportunity cost), and because Australian operations are fundamentally different from competitor nations. Therefore, we have also excluded molasses to ethanol technology in our comparisons. We prefer pathways that maximise sugarcane production, preserves sucrose markets and provides diversification and market opportunities.

Other emerging pathways

Several viable biofuel/bioenergy pathways from sugarcane by-product pathways merit further investigation but are not included in this submission. These include tops and trash to bioenergy (i.e., see sky renewables technology[8], bagasse-palletisation for market export, bagasse to biogas/biomethane and Mill Mud/Ash to biogas/biomethane (via anaerobic digestion).

Each biofuel pathway presents a unique set of challenges and trade-offs, and must be weigh against the emissions abatement benefits, economic value, and scalability. Future technology breakthroughs will allow already modernised mills to adapt and pivot more quickly toward production of alternative fuels, from multiple feedstock combinations.

Recommendation:

- Sugarcane pathway prioritisation: Progress pathways that enables sugarcane ‘all of crop’ manufacturing, preserves core sucrose processing, and expand market diversification opportunities, while investigating the development of all feasible sugarcane to biofuel and bioenergy pathways, to maximise long-term diversification potential and market access.

[8] https://skyrenewables.com.au/

Table 4: Viable and Probable Sugarcane Conversion Pathways.

Metric	Crystal Sugar → Ethanol	Ethanol → SAF (From Crystal Sugar (AtJ)	Bagasse → Ethanol	Bagasse → SAF (AtJ)	Bagasse → SAF (Licella)
Feedstock	4 Mt Sucrose	2.6 BL Ethanol	9 Mt bagasse	9 Mt bagasse	9 Mt bagasse
Primary fuel output	Ethanol	SAF	Ethanol	SAF	SAF
Fuel yield per tonne feedstock	~620-680 L ethanol = 1/t sugar	~0.47 litres of SAF= 1/L ethanol	~250–280 L ethanol/t = 1/t bagasse	~118–131 L SAF/t bagasse	~139 L SAF/t bagasse
Fuel produced (litres)	~2.48-2.72 BL	~1.22 BL (SAF via AtJ)	~2.25–2.52 BL	~1.06–1.18 BL (SAF via AtJ)	~1.25 BL
Unit Price per Tonne/Litre	Wholesale ethanol @ $1.565/L	SAF at ~$0.82/L (2-5x jet fuel proxy	Wholesale ethanol @ $1.565/L	SAF at ~$0.82/L (2-5x jet fuel proxy)	SAF at ~$0.82/L (2-5x jet fuel proxy)
Economic value (Total production)	**AUD ~3.88-4.29B (Ethanol) -**	**AUD ~1.00B (SAF)**	**AUD ~3.52–3.95B (Ethanol)**	**AUD ~0.87–0.97B (SAF)**	**AUD ~1.02B (SAF)**
Less Indicative Cost	$A1-1.50/L	~ A$2.12–2.80/L	~A$0.75–1.10/L	~A$2.5–4.5/L	~A$1.3–2.5/L
Conversion pathway	Fermentation	Fermentation → via (AtJ)	Fermentation/ cellulosic	Fermentation → via (AtJ) REACH™	Cat-HTR™ Hydrothermal Liquefaction
Feedstock type	Edible sugar	Derived from Edible sugar	Non-edible residue	Non-edible residue	Non-edible residue
Technology stage	Gen 1 biofuel Mature Internationally / No Domestic Production	Gen 1 biofuel Mature Internationally / No Domestic production / Project Ulysses-Jet Zero pilot	Gen 2 biofuel Pilot Scale Internationally/ No Domestic production	Gen 2 biofuel Commercially unproven domestically & internationally / Domestic Project Mercurius Pilot	Gen 2 biofuel Emerging/ advanced /Domestic – (commercial demo stage)
By-products	CO_2, water	CO_2, water	Lignin, CO_2	CO_2, water	Renewable diesel, naphtha
Economic value to growers (10%)	No Feedstock Market Price	No Feedstock Market Price	No Feedstock Market Price	No Feedstock Market Price	Not Disclosed
Notes – **See Appendix C-for Key Assumptions**	(competes with food/feed use)	Requires 2 steps (competes with food/feed use)	Residue valorisation	Requires 2 steps	Higher carbon retention & feedstock flexibility

See Assumptions – Appendix C

ECONOMIC VALUE OF SUGARCANE PATHWAYS

Sugarcane Feedstock

The Queensland's feedstock study and National Bioenergy Feedstock Strategy reports, once completed, may provide clarity on feedstock types, volumes and locations, for biofuel production. This information will offer investors and producers the confidence necessary to commit capital and enter short-term and long-term supply contracts. This strategy change will require consideration to existing domestic and export feedstock supply agreements to avoid disruption of established markets.

Sugarcane Biofuel Security for Defence, Agriculture and more

The CEFC (2025), report, proposes Australia has the network, resources, arable land, and capability to be a significant producer of biofuels with current project pipelines of 2 billion litres per annum and growing.

Table 4 shows, sugarcane industry could produce over 2 billion litres of ethanol, 1 billion litres of SAF, or sufficient renewable diesel (i.e., Licella technologies). Such technology advancements and outputs could provide biofuel security for Australia's defence sector and supplement domestic agricultural diesel consumption, reducing reliance on fossil imports.

Biofuel Cost of Production

The economics of biofuel production costs are strongly influenced by feedstock choice and conversion technology:

- **Ethanol (molasses-based, Gen 1):** Feedstock costs represent 70–85% of production cost. Global benchmarks estimate production at around **AUD $1.50/L**, with a range of **AUD $0.75–1.20/L**[9], depending on feedstock price.
- **Ethanol (cellulosic, Gen 2):** Pilot plants in Australia estimate production costs at **AUD $0.51–0.67/L**, demonstrating potential efficiency gains over time.
- **Ethanol (starch-based):** A 2016 IPART study found wheat-based ethanol cost around **AUD $0.64/L**.
- **SAF (from various pathways)**[10]: Costs remain significantly above conventional jet fuel. Estimates suggest production costs are **2–4 times higher**, or **AUD $2.50–4.50/L**[11], depending on technology.
    - CEFC (2025) modelling suggests:
        - HEFA (waste oils): **AUD $3.53/L**
        - Sugarcane AtJ: **AUD $4.62/L**
        - Bagasse FT: **AUD $6.32/L**
    - Global estimates range from **USD $1.83–3.00/L** (≈ AUD $3.00–5.00/L)[12].
    - No definitive cost estimates yet exist for SAF produced from sugarcane in Australia.

[9] https://www.fsa.usda.gov/Internet/FSA_File/ethanol_fromsugar_july06.pdf
[10] Sustainable Aviation Fuel from Ethanol: Techno-Economic Analysis and Life Cycle Analysis
[11] Alternative feedstocks for sustainable aviation fuels: Assessment of sugarcane-derived microbial oil - ScienceDirect
[12] Modeling the price relationships between crude oil, energy crops and biofuels - ScienceDirect

Price Points and Market Competitiveness

Bioethanol is generally considered cost-competitive with petrol only when global crude oil prices are high. The exact price parity point depends on feedstock costs and plant efficiency, but ethanol tends to become a viable alternative when petrol prices increase significantly, driving demand for substitutes.

For SAF, competitiveness will rely less on parity with fossil jet fuel and more on policy levers such as blending mandates, carbon pricing, and price mechanisms that can bridge the cost gap until scale economies and technology advances reduce production costs[13].

Key biofuel pathway risks and barriers

The Clean Energy Finance Corporation's 2025 report highlights a range of production to market and investment risks and opportunities, namely, *demand and price uncertainty, feedstock risk, immature technology deployment or advancements and policy/regulatory risks and uncertainty*, which must be carefully considered when progressing toward viable and enduring biofuel pathway for Australia.

Other barriers are production cost premiums, feedstock variability and competition, land purpose use and sustainability certification not reflective of Australian context.

Derisk Capital Investments

Along the biofuels value chain, participants seek certainty and derisk opportunities entering a domestic market. The creation of long-term contracts and agreements, together with appropriate funding and financing arrangements will be essential to provide predictability of cashflows and confidence to participate in a biofuels industry.

There are two financial elements that must be addressed to enable the development of a viable biofuels sector.

First, capital investment required to establish biofuel production facilities at source feedstock locations, that would produce sufficient liquid biofuel stocks to support a 10 per cent biofuel "drop-in" to Australia's 60 billion litre annual liquid fuel market. This investment is estimated at between $25 billion and $30 billion[14]. The scale of such an investment is achievable, provided the right policy mechanisms are in place to underpin market certainty and investor confidence.

Second, parallel investment is needed to establish a domestic biofuel trading market and implement supply-side mechanisms (noted above). Such mechanisms are essential to narrow the price differential between biofuels and fossil fuels, thereby enabling domestic production to become commercially viable. Without these mechanisms, biofuels will struggle to gain a foothold in the Australian market, let alone accelerate to scale, refer to the seven accelerators to scale up Australia's liquid fuel market, (CEFC, page 79, 2025)[15].

Capital verses Financing

We concur with the CEFC preference for use of debt to capital solutions[16], which provide a risk adverse approach to project development, rather than more an aggressive equity approach, which requires

[14] biofuels-and-transport-an-australian-opportunity-november-2019.pdf
[15] Refined Ambitions Exploring Australia's Low Carbon Liquid Fuel Potential - Clean Energy Finance Corporation
[16] Maloney, R., Executive Director, Alternative Fuels, CEFC, remarks during Green Room Webinar, 25 July 2025, 27 minutes

return on investment outcomes. This must be weight against a whole of industry approach, diversification opportunities and the benefit to different market sectors, and the nation more broadly.

Market funding mechanisms must take a whole of market approach. Support for short-term incentives such as grants, project seed funding, offset schemes, conditional production incentives, contracts for difference, or accreditation and certification programs increase risk of short-term thinking, siloed sector design outcomes, and of being manipulated over time, creating inefficiencies, such as, lower-cost (ethanol) imports or monopolising the Cleaner Fuels Grant Scheme.

Recommendation

- All financial instruments and programs should be designed with a long-term horizon (25–50 years) to enable the development, maturation, and growth of a sustainable biofuel sector in Australia. This approach provides certainty for investors, ensures continuity of supply chains, and supports the scale of infrastructure required for national fuel security and carbon abatement.

POLICY AND FUNDING MECHANISMS

Demand-side and Supply-Side Support Mechanisms

A price gap exists between fossil fuels and the production of biofuels, estimated at 2-5 times or more, which places enormous pressure on Australia's productivity outcomes and increases cost of living for everyone. To bridge the gap, clear and consistent policy and regulatory settings are essential to provide certainty for agricultural producers, manufacturers, supply chains, and investors.

These settings should include both demand-side measures, such as mandates, and supply-side supports, such as production incentives or credits, tax concessions, offset agreements, and price mechanisms, rebates, to unlock offtake. Together, these measures can help close the current price differential between biofuels and fossil fuels, thereby lowering the retail cost of biofuels for end-users and supporting sectors that cannot (currently) absorb or transfer the higher cost of biofuel inputs, i.e., price taker sectors.

The growth of biofuels production capacity will benefit from tightly connected demand-side and supply-side mechanisms that operate in a complementary manner and extend beyond Queensland's existing biofuel mandate (e.g., E10). *(Source: Clean Energy Finance Company (CEFC) - Refined Ambitions: Exploring Australia's Low Carbon Liquid Fuel Potential, 2025. page 29)*[17].

Appendix A outlines the current domestic and international liquid fuel policy levers available for consideration by governments and industry.

Market Adoption

The roles of all parties to a liquid fuel market must be addressed through a balanced and well thought out structure – a policy framework that captures capacity and capabilities to meet a biofuel drop-in fuel blend, contributing toward the 60 billion litres of fossil fuel consumed annually. The are:

- The Producer and feedstock provider
- Project developer

[17] *Refined Ambitions Exploring Australia's Low Carbon Liquid Fuel Potential - Clean Energy Finance Corporation*[17]

- Off taker
- Finance/Capital provider – likely in the form of concession/debt.
- Government – policy perceptive

Recommendation

- Protect against cost pass-throughs: All policy and production incentives must be structured to ensure that the costs of liquid biofuels are not borne by agriculture, supply chains, or end-users. Avoiding inflationary triggers is critical to safeguarding farm businesses and regional communities.

POLICY, REGUALTION AND LEGISLATION REFORM

Targeted government policy reform is required in several foundational policy pillars of the agricultural production system should producers, supply and value chains remain profitable and competitive domestically and internationally.

Foundational policy pillars of agricultural production.

1. **Biosecurity systems:** strengthen capacity to protect production, maintain market access, and respond rapidly to emerging foreign and domestic threats.
2. **Infrastructure:** invest in regional infrastructure assets and network (i.e., road, bridges, rail, port, delivery assets etc) to ensure effectiveness of the production system is maximised.
3. **Production input security:** access to reliable and affordable inputs; energy, water, fertiliser pesticide, machinery and equipment, etc.
4. **Telecommunications and Connectivity:** secure and reliable telecommunications networks to ensure innovation and sovereign capability.
5. **Workforce, health and education:** access for regional communities to attract and retain the people essential for production and processing.
6. **Diversified and transparent supply chains:** build resilience to shocks while ensuring fair and transparent market access, and adequate control mechanisms to trade.
7. **Research, development and innovation:** domestic adoption of Australian innovations that underpin productivity, competitiveness, and resilience, achieving future competitive edge.
8. **Regulatory Barriers – red-tape and green-tape** imposes significant restrictions on the agricultural sector, its supply chains, workforce, and infrastructure networks, with constraints often hinder or even prohibit the development of a biofuel industry.
9. **Regionalisation:** supporting regional business, local retailers and manufacturers is critical to the sustainability of long-term food and fibre production capacity and local value add, while reducing cost-of-living pressures. *See repopulation of regions below.*
10. **Climate change:** efforts to respond to climate change should be done in a manner that does not threaten food production. The Paris Agreement 2015.

KEY POLICY STRATEGIES

Strategic Land Purpose use

Agricultural regulations and restrictions on agricultural land use, production, including commercial operating restrictions, coupled with slim profit margins, and reducing productivity gain is displacing the family farm business, with sugarcane and agricultural land under production decreasing, due to increasing cost to maintain asset values; competition of land purpose use (i.e., nature reserves, nature repair policy, environmental offsets, wind and solar renewables), and from corporate agricultural managers; resulting in depopulation of regional communities.

Repopulation of regional communities

The Queensland Government (2025), bioenergy submission suggests sugarcane land available for production is not being maximised. Alleviating the pressure points in the agricultural production system, by addressing all the foundational pillars (above) will allow for great profitability and therefore, greater reinvestment of funds toward innovation, productivity improvements, resulting in a stronger agricultural sector, allowing the repopulation of regional communities, because of workforce opportunities, and ultimately reinforcing Australia cultural identity as a large land base with vast resource and food and fibre production capabilities that offers global food and fuel security.

Food verses Fuel

The use of sugarcane by-products, i.e., bagasse, rather than diverting crystal sugar away from food markets, creates the greatest diversification pathways for industry, while leverage profit opportunities, without compromising food security or impacting our existing sugarcane export industry. This pathway avoids the “food versus fuel” dilemma.

Research and Development Agenda – Sugarcane Genome

The sugarcane genome is the most complex of any crop and 3 times the size of the human genome, however in 2024, the sugarcane genome (DNA) was sequenced, now researchers may engineer more sugarcane fibre-rich varieties (with increased structural biomass/lignocellulosic fibre) in support of a biofuels industry and reduced reliance on fossil fuels pathways[18].

Governments and research institutions must play a more central role in accelerating the development and commercialisation of emerging technologies, i.e., agricultural practices manufacturing processes, supply chain value adds, and most importantly, the fast-tracking of emerging biofuel technologies pathways to market.

[18] The complex polyploid genome architecture of sugarcane | Nature

PRODUCER DIVERSIFICATION AND BIOENERGY OPPORTUNITIES

What the industry needs is certainty, and that only occurs through development of long form policy and frameworks enshrined in regulation and legislation.

Achieving a liquid fuel market, fuel security and reaching net zero by 2050, will require industry collaboration and a coordinated alignment across portfolios – departments and agencies with specialist knowledge and expertise. *(These activities must be undertaken and led by government departments and agencies with specialist knowledge and expertise across numerous portfolios)* [19]. Further supported by modelling, cost-benefit analysis, business planning, and collaboration with producers' and industry to bring models to market.

At the centre of the opportunities, are the sugarcane producers; the foundation of an already diversified market sector; seek to be consulted in tandem; and given right pathway(s), policy, regulations, legislation certainty, producers will deliver productivity gains and profits, offering improved outcomes for regional communities and the nation.

If you have any questions or require further information, please contact Sam Forzisi, AgForce Policy Director, by email: [redacted] or on mobile: [redacted]

Yours Sincerely,

[redacted]

Mr Shane McCarthy
General President
AgForce Queensland Farmers Ltd

[19] https://www.infrastructure.gov.au/sites/default/files/documents/aviation_green_paper.pdf

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APPENDIX A: Biofuel Policy Levers

Domestic Levers

Future Made in Australia (FMIA) Framework, innovation fund, with package designed to target biofuels – low-carbon liquid fuel projects, includes, the

ARENA (Australian Renewable Energy Agency) provides grant funding for bioenergy and liquid fuels R&D and demonstration projects, especially for hard to abate sectors.

Clean Energy Finance Corporation (CEFC), offers concessional loans, equity, and debt financing for renewable energy projects

Guarantee of Origin Scheme (GO Scheme) for low carbon liquid fuels, an in development a certification (Product Guarantee of Origin (PGO), assurance and traceability of emissions carbon intensity over the production lifecycle

Safeguard Mechanism, designed to reward production plants making liquid fuels that reduce emissions allowing them to generate Safeguard Mechanism Credit Units (SMCs), consequently, a production facility that exceeds baseline emissions, must either reduce emissions or surrender Safeguard Mechanism Credit Units (SMCs).

Fuel Quality Standards Act 2000 (and amendments), sets legal standards for fuels sold in Australia, with amendments in progress to allow broader blending of renewable diesel and SAF into the domestic market.

Fuel Excise Credit / Tax Concessions, similar to the fuel excise credit for non-public road vehicles, similar credits or tax concessions would help reduce the price gap between fossil fuel and biofuel.

Production credits, a monetary value to reduce production costs of liquid renewable fuel, reducing biofuel cost premium. i.e., Cleaner Fuels Program.

International Levers

the US Renewable Fuel Standard Mandates, which commenced in 2005 – blending mandate.

The US Inflation Reduction Act 2022, performance-based tax credit for the production of low emission transportation fuels.

California's Low Carbon Fuel Standard (LCFS) program requires fuel providers to reduce the carbon intensity (CI) of their transportation fuels over time through yearly declining benchmarks.

Brazil's (Proálcool) program 1975, government-backed initiative to produce and use ethanol from sugarcane as a replacement for petrol, means to increase energy/fuel security and National biodiesel production program 2005, mandatory blending of biodiesel with petroleum, aimed at the sustainable implementation of biodiesel production and use.

ICAO CORSIA (Carbon Offsetting and Reduction Scheme for International Aviation), global market-based scheme to cap emissions, and achieve carbon neutral growth, mandatory compliance after 2027.

EU and UK, SAF Mandates, increasing the use of SAF starting 2025:

- **EU – RED III,** renewable fuel targets, of 29% by 2030.

- **EU – REFuelEU** Aviation regulation (Mandate), starting with 2% SAF Mandate in 2025, aiming for 70% SAF mandate by 2050.
- **UK - Power-to-Liquid (PtL)** (Mandate), increase obligation of low carbon hydrogen pathways from 2028, increasing to 3.5% by 2040.
- **UK- HEFA-SAF** (Mandate), starts in 2025, a cap on HEFA use, with reduction obligation to move to more advanced pathways, as developed.
- **UK -buy-out mechanism,** as compliance option, allows suppliers cannot supply sufficient SAF, a buy-out price, rather than surrender certificates.

APPENDIX B: International biofuel pathways from Sugarcane

- crystal sugar/molasses to ethanol (generation 1) – existing markets, e.g., Brazil, USA, and two production facilities in Queensland, Sarina and Dalby plants in Queensland.
- ethanol to SAF or Renewable Diesel (RD) (generation 2) conversion of bioethanol to Sustainable Aviation Fuel (SAF), using Alcohol to Jet (AtJ) technology, no commercially operating plants – although pilot plants in development e.g.,
    - GranBio/Honeywell - Brazil)[20].
    - DG fuels/NextChem – USA[21], set to be the first commercial scale plant to come online sometime in 2025. Submission - QLD Government 2025 and
    - Project Ulysses, Townsville Australia, developed by Jet Zero, set become operational by 2027/2028, using LanzaJet technology.
- Bagasse to ethanol (generation 2) – no commercial-scale facility anywhere in the world – although a number of pilot projects operating, e.g.,
    - Raízen (Brazil), production ~112–124 ML/yr
    - GranBio (Brazil) – BioFlex I (Alagoas), production~30 ML/y
- Bagasse to SAF or Renewable Diesel (generation 2) - no commercially scalable projects, however leading projects are in development, e.g.,
    - DG fuels/NextChem – USA[22], in Georgia, United States, and
    - GranBio/Honeywell - Brazil
    - Licella (Australia, QLD), Isis Central Sugar Mill— "Project Swift" — HTL Hydrothermal Liquefaction (HTL), (Cat-HTR™), ~60 ML/yr biodiesel fuels incl. ~40 ML/yr SAF, operational by 2026.
    - The Mercurius biorefiing, Mackay Queensland, REACH™ Technology,

Other biofuel technology pathways (non-sugarcane)

Fischer–Tropsch (FT) for syngas (carbon monoxide (CO) and hydrogen (H_2), bagasse to SAF or RD, (currently pilot trials in Brazil), and

HEFA (Hydrotreated Esters and Fatty Acids), using vegetable oils or animal fats (not sugar), currently commercially available globally, most cost effective and productive, with lowest cost to abatement, with pilot project planned by Ampol and GrainCrop commercial production 2030. However, CEFC suggests possible HEFA production profitability has a tipping point, due to feedstock limited resource, as new technology develops, and cost of green hydrogen production becomes more efficient

Power to Liquid (PtL), a synthetic liquid fuel produced by using electricity from renewable sources to convert water and a captured carbon source, like CO_2, into liquid hydrocarbons for SAF or renewable fuels, these are not yet commercially viable biofuels pathways.

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APPENDIX C: ASSUMPTIONS TABLE – Sugarcane Biofuel Pathways

Input / Parameter	Assumption Value	Notes / Source
Cane throughput	30 million tonnes cane (annual, Australia baseline)	National average crush (AgForce, ABS)
Sugar yield (crystal sugar)	~4 Mt sugar (≈13.68 % recovery)	Standard cane CCS ~13.68%
Bagasse yield	~9 Mt (≈30% of cane weight)	Industry average
Molasses yield	~1.0–1.2 Mt (≈3–4% of cane weight, ~0.25–0.30 t/t sugar)	Queensland mill data
Bagasse energy content	~7.5 GJ/tonne (LHV, wet basis)	Energy conversion factor
Ethanol yield (from bagasse via enzymatic hydrolysis)	250–280 L/t bagasse	Assumed 60–70% conversion of cellulose
Ethanol yield (from molasses)	~250 L/t molasses	Industry conversion factor
Ethanol yield (from crystal sugar/sucrose)	~620 L/t sugar	Fermentation theoretical yield
SAF yield (via AtJ from ethanol)	~0.47 L SAF per 1 L ethanol	ASTM AtJ pathway
SAF yield (via Licella HTL, bagasse)	~139 L SAF/t bagasse	Licella Cat-HTR™ study assumption
Renewable diesel yield (via FT, bagasse)	~75 L/t bagasse (30–40% efficiency)	Biomass-to-liquid gasification conversion
Electricity yield (bagasse cogeneration)	~520 kWh/t bagasse gross (25% efficiency)	Assumes HP boiler conversion
Mill electricity use	~20% of generated power retained for milling	Internal consumption baseline
Molasses price (export / feed)	~AUD $250/t	Historical trade values
Ethanol price	~AUD $2.00/L	Globalpetrolprices.com
SAF price assumption	2–5 × jet fuel (~AUD $1.65/L jet baseline) = $3.30–$8.25/L	IEA/ICAO ranges
Sugar price (ICE)	~AUD $500/t	Market baseline
Wholesale electricity price (QLD)	AUD $136–$188/MWh (AER, 2025)	Recent regulator averages
Revenue to growers	~10% of industry value	Standard cane payment system

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